

بسم الله الرحمن الرحيم





شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار





بعض الوثائق الأصلية تالفة





بالرسالة صفحات
لم ترد بالأصل





ROLE OF DWI IN EVALUATION OF HCC AFTER RADIOFREQUENCY ABLATION COMPARED TO DYNAMIC MRI USING MRI (3 tesla)

Thesis

**Submitted for partial fulfillment of Doctorate Degree in
Radio-diagnosis**

By

Bahaa Mohamed Elrefaey Hasan

M.B. B. Ch., M. Sc

Faculty of Medicine – Ain Shams University

Under Supervision of

Prof.Dr. Hanaa Abd El Kader Abd ElHamid

Professor of Radio-diagnosis

Faculty of Medicine, Ain Shams University

Ass. Prof. Dr. Nivan Hany Khater

Assistant Professor of Radio-diagnosis

Faculty of Medicine, Ain Shams University

Ass. Prof. Dr. Ahmed Samy Abdelrahman

Assistant Professor of Radio-diagnosis

Faculty of Medicine Ain Shams University

Ass. Prof. Dr. Waseem ElGendy

Assistant Professor of Radio-diagnosis

Medical Military Academy

**Faculty of Medicine
Ain Shams University
2021**

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

لسببائك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

سورة البقرة الآية: ٣٢



Acknowledgments

*First and foremost, I feel always indebted to **Allah**, the Most Beneficent and Merciful who gave me the strength to accomplish this work,*

*I would like to express my deepest gratitude to Prof. **Dr. Hanaa Abd Elkader**, Professor of radio-diagnosis, Faculty of Medicine, Ain Shams University, Cairo, for her fatherly care, continuous encouragement and guidance.*

*I wish to offer my sincere thanks to **Dr. Nivan Hany Khater**, Assistant professor of radio-diagnosis, Faculty of Medicine, Ain Shams University, **Dr. Ahmed Samy Abdelrahman**, Assistant professor of radio-diagnosis, Faculty of Medicine, Ain Shams University and **Dr. Wassem ElGendy**, Assistant Professor of Radio-diagnosis, Military Medical Academy for their valuable assistance and moral support, which have always been beyond description.*

*My deepest thanks are sincerely offered to my **family** and **friends** for their continuous encouraging attitude & moral support.*

 *Bahaa Mohamed Elrefaey Hasan*

List of Contents

<i>Subject</i>	<i>Page No.</i>
List of Abbreviations.....	i
List of Tables.....	iii
List of Figures	iv
Introduction	1
Aim of the Work.....	4
Review of Literature	
MRI Anatomy of the Liver	5
Pathology and MR features of Hepatocellular Carcinoma	12
Role of radiofrequency (RF) in Treatment of HCC.....	32
MRI Technique for Liver Imaging.....	48
Principles of Diffusion-weighted MR Imaging	61
MRI Features of HCC after radiofrequency ablation.....	75
Patients and methods	97
Results.....	106
Discussion	121
Illustrative Cases	130
Summary and Conclusion	146
References	148
Arabic Summary	—

List of Abbreviations

<i>Abbr.</i>	<i>Full-term</i>
ADC	: Apparent Diffusion Coefficient.
AFP	: Alpha-fetoprotein.
AP	: Arterial phase
APHE	: Arterial phase hyper enhancement
CECT	: Contrast enhanced computed tomography
Cha	: Common hepatic artery
CT	: Computed Tomography.
DEB	: Drug eluting beads.
DP	: Delayed phase
DW	: Diffusion Weighted.
DW MRI	: Diffusion Weighted Magnetic Resonance Imaging.
DWI	: Diffusion Weighted Imaging.
DWIs	: Diffusion Weighted Images.
EPI	: Echo planner imaging
FA	: Flip Angle.
FFE	: Fast Field Echo
Fig	: Figure.
FL	: Falciform Ligament
FOV	: Field of View.
FS	: Fast Spin.
FSE	: Fast Spin Echo
FSPGR	: Fast spoiled gradient echo
Gd	: Gadolinium.
Gd DTPA	: Gadolinium - diethylene-triamine- penta-acetic Acid
GRAPPA	: Generalized auto-calibrating partially parallel acquisition
GRE	: Gradient Recalled Echo.

HASTE	: Half-Fourier acquisition single-shot turbo spine-echo
HBP	: Hepatobiliary phase.
HBV	: Hepatitis B Virus
HCC	: Hepatocellular Carcinoma.
HCV	: Hepatitis C Virus.
HGDN	: High grade dysplastic nodule
INR	: International normalized ratio
IP	: In phase.
IV	: Intravenous.
IVC	: Inferior Vena Cava.
lha	Left hepatic artery
LHV	: Left Hepatic Vein.
LI-RADS	: Liver Imaging Reporting and Data System
LRT	: Loco-regional therapies.
LV	Ligamentum venosum
mha	Middle hepatic artery
MHV	: Middle Hepatic Vein.
Min	: Minute.
MIP	Maximum intensity projection
Mn-DPDP	: Mangafo dipir trisodium.
MP-RAGE	: Magnetization Prepared Rapid Acquisition Gradient Echo.
MR	: Magnetic Resonance.
MRA	: Magnetic Resonance Angiography.
MRI	: Magnetic Resonance Imaging.
MSCT	: Multi Slice Computed Tomography.
msec	: Millisecond.
nADC	: Normalized Apparent Diffusion Coefficient.
NEX	: Number of Excitations.
NPV	: Negative predictive value
NSF	: Nephrogenic systemic fibrosis
OP	: Out of phase

PD	: Progressive disease
Post-Gd	: Post Gadolinium.
PPV	: Positive predictive value
PR	: Partial response
PT	: Prothrombin Time.
PVP	: Post venous phase.
RARE	: Rapid Acquisition with Relaxation Enhancement.
RECIST	: Response evaluation criteria in solid tumors
RF	: Radio-Frequency.
RFA	: Radio-Frequency ablation
Rha	: Right hepatic artery
RHV	: Right Hepatic Vein.
RN	: Regenerative nodule
ROC	: Receiver operating Characteristic
ROI	: Region of Interest.
RT	: Respiratory triggered.
RUQ	: Right upper quadrant.
S	: Second.
SE	: Spin Echo.
SEC	: Second.
SENSE	Sensitivity encoding
SGE	: Spoiled Gradient Echo.
SI	: Signal Intensity.
SNR	: Signal to Noise Ratio.
SPAIR	: Spectral Attenuated Inversion Recovery (fat suppression MR technique).
SPIO	: Superparamagnetic Iron Oxide.
SS-ETSE	: Single -shot echo train echo.
STIR	: Short time inversion recovery.
T	: Tesla.
T2*	: Fat Saturation T2.
Tab	: Table.
TACE	: Transarterial chemoembolisation therapy

TE	: Echo Time.
THRIVE	: High Resolution Isotropic Volume Examination.
TNM	: Tumor, Lymph nodes, Metastasis.
TR	: Treatment response
TR\	: Repetition Time.
TRWG	: Tumor response work group
TSE	: Turbo Spin Echo.
US	: Ultrasonography.
VIBE	: Volumetric interpolated breath-hold examination
WIs	: Weighted Images.
2D	: Two Dimension.
3D	: Three Dimension.

List of Tables

Table No.	Title	Page No.
Table (1):	Risk factors of HCC.....	14
Table (2):	Microscopically and Histopathological Grading of HCC.....	15
Table (3):	Recommendations for HCC surveillance: categories of adult patients in whom surveillance is recommended	16
Table (4):	Visual liver lesion characterization with DW MR imaging	68
Table (5):	Interpretation guidelines for DW-MRI.....	79
Table (6):	mRECIST criteria for HCC	81
Table (7):	LI-RADS Treatment Response Categories.....	95
Table (8):	Patient sex Data	106
Table (9):	LR-TR viable and non-viable lesions.....	108
Table (10):	Size statistical analysis.	109
Table (11):	T1W & T2W signals.....	110
Table (12):	Statistical analysis of lesions borders.	112
Table (13):	DCE results statistical analysis.....	114
Table (14):	DWI results statistical analysis.....	116
Table (15):	ADC statistical analysis.....	117
Table (16):	Different ADC indices.....	118

List of Figures

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
Figure (1):	(a–g): Segmental liver anatomy in MRI.....	6
Figure (2):	T1 and T2 WIs appearance of the liver.....	11
Figure (3):	HCC and micronodular cirrhosis.....	14
Figure (4):	Stepwise pathway of carcinogenesis for HCC in cirrhosis.....	18
Figure (5):	Diagnostic algorithm and recall policy for a mass/nodule in cirrhotic or non-cirrhotic livers.....	19
Figure (6):	MRI features of HCC	21
Figure (7):	Typical hepatocellular carcinoma	23
Figure (8):	Hypovascular HCC with fat	25
Figure (9):	Large solitary HCC	26
Figure (10):	HCC with capsule.....	27
Figure (11):	MRI at 5 month post operatively	29
Figure (12):	Infiltrative hepatocellular carcinoma with tumor thrombus	30
Figure (13):	A simplified schematic representation of the typical imaging features of the most commo cirrhotic lesions.....	31
Figure (14):	Radiofrequency ablation of a liver tumor under 2D US.....	37
Figure (15):	Post treatment hemorrhage.....	40
Figure (16):	Pneumothorax in 68 male patient after RFA of HFL at segment VIII	44